LIBRARY
OF THE
MASSACHUSETTS INSTITUTE
OF TECHNOLOGY

MASS. INST. TECH.
OCT 18 1973
DEWEY LIBRARY

A CATEGORIZATION OF THE LATIN AMERICAN NATIONS ACCORDING TO THEIR POTENTIAL FOR DEVELOPMENT OF A COMPUTER INDUSTRY

Ramón C. Barquín

Massachusetts Institute of Technology

678-73 October 1973

HD28
.M414
no.678-73

RECEIVED
OCT 30 1973
M. I. T. LIBRARIES

TABLE OF CONTENTS:

Introduction----------4

Description of Method----------5

National Magnitude Sets----------18

Sources and Reliability of Data----------19

Analysis of CIDP----------38

Characterization and Summary----------41

References----------55

Bibliography----------56

0718684

LIST OF TABLES:

Table 1: Weighing Factors and their Identifying Codes----16
Table 2: Chart of Factors and Assigned Weights----------17
Table 3: Table Relating Factors to Most Common Source----23
Table 4: Determination of Economic Parameters----------24
Table 5: Determination of Educational Parameters---------25
Table 6: Determination of Technological Parameters-------26
Table 7: Raw Data for Economic Sector--------------------27
Table 8: Raw Data for Educational Sector-----------------28
Table 9: Raw Data for Technological Sector---------------29
Table 10: Computations to Convert Raw Data to Points-----30
Table 11: Point Distribution in Economic Sector----------31
Table 12: Point Distribution in Educational Sector-------32
Table 13: Point Distribution in Technological Sector-----33
Table 14: Ranking by Sector-----------------------------34
Table 15: Table of CIDP Indicator Groups-----------------35
Table 16: National Magnitude Sets-----------------------36
Table 17: Affine CIDP within National Magnitude Sets-----37
Table 18: Mapping of CIDP Groups to Expanded UN Levels---45
Table 19: General Information on Latin American Nations--54

Introduction:

One of the greatest problems in dealing with developing countries has been that of indiscriminate generalization; attempting to measure different lands and peoples with the same yardstick. The many idiosyncracies which characterize the nationals of different countries make these attempts nothing more than frustrating and futile efforts with results generally detrimental to the desired goals. On the other hand, it is also unrealistic to attribute uniqueness to every facet of life within a developing country. Each pair of nations has certain similarities and differences. Some countries, with strong ethnical, geographical, or cultural ties have great areas which are common to their national development. Still, others have problems of parallel nature due to economic links, or chronological similarities in their historical development. It becomes quite important, at a certain point, to study those aspects which tend to place countries in specific affinity groups depending on a common factor of analysis. This is especially so today, since interdependence is a patent necessity, and nations must learn from each other's actions. The solution to a specific problem in one country could very well be of great value in aiding another country in deciding upon a strategy towards attacking a similar situation. In developing nations, handicapped by the many difficulties in the process, and ever so zealous of making the best use of their scarce resources, this sharing becomes quite important. Determining, therefore, general groups of nations with similar characteristics relevant to the area in which sharing is to take place, is of a high priority.

Description of Method

Our primary intention is to deal with the possibilities of automated data processing in Latin America. We wish to avoid the usual errors of generalization, so a categorization of the twenty-one nations included in the region will be made. The countries to be treated are the following:

ARG Argentina
BOL Bolivia
BRA Brazil
CHI Chile
COL Colombia
COS Costa Rica
CUB Cuba
DOM Dominican Republic
ECU Ecuador
ELS El Salvador
GUA Guatemala
HAI Haiti
HON Honduras
MEX Mexico
NIC Nicaragua
PAN Panama
PAR Paraguay
PER Peru
PRC Puerto Rico
URU Uruguay
VEN Venezuela

A classification with respect to the potential for developing a computer industry needs an analysis of the factors relevant to that potential. The initial establishment of data processing installations, and their most effective and efficient use, is in direct relation to a number of factors. Among these:

1. How well does the system fit the job?

2. How well is the people know the system?

3. What is the manpower availability to service all facets of the system?

4. How well does the system blend in with

the current state of technology in the country?

b. How well justified is the system, from a socio-economical point of view?

Asking how well a system fits a job is attempting to find a measure for the relation between the optimal processing capacity of the system, as well as its optimal mode of operation, and that at which it is actually being utilized. This basically means that in order to accomplish a prescribed group of tasks, in given volumes and within certain time constraints, there is probably a small subset of systems which fit best. This is by no means the only factor for selection, but it is one of those involved, and a most important one at that. In addition, the economical aspects must be analyzed and a price-performance ratio determined to evaluate what is being obtained for the money being paid.

The knowledgeability of all computer professionals, whether they be operators, programmers, managers or general users, is crucial. Effective usage means that preset goals are accomplished in relatively short periods of time. For this, experience is decisive. Efficient usage means that goals are accomplished at minimal plausible costs. For effective usage, granted the need for personnel with the necessary expertise, said skills level may be imported. For efficient usage, in the long run, native personnel must be trained until made to achieve the expertise required. A compromise for marrying the two is one of the most critical aspects of introducing computer technology in developing countries.

manpower sources that guarantee continuous operations of our installations at reasonably high rates of efficiency are also fundamental. Again, there must be access to the people that can insure this, whether they be in programming, operations, or hardware servicing. These sources should either exist prior to the time of installation, or they must be created shortly after, while initial manpower is imported.

The current state of technology in a nation is very difficult to determine. This is primarily so in nations where due to isolated initiatives, a relatively advanced sector might exist, yet the country as a whole be considerably backward. This is characteristic, sometimes, of foreign plants in developing countries, which create a pocket of advanced technology in their specialization, and also implant the necessary environment to support that level of technology in those areas vitally connected with their commercial life. The degree of benefit for the host nation, in this sense, is greatly dependent on a number of factors. The spectrum ranges from the extreme case of, say, the Guantanamo Naval Base, in Cuba, with no benefit absolutely to the Cubans in the sense of increasing the state of technology; to that of the many small American subsidiaries in Puerto Rico, with total native manpower from the general manager down, and complete access to the parent firm's bank of technology. More a propos is to take the example of a typical oil refinery, with all its necessity for equipment, power plants, communication lines, harbor facilities, etc. In addition, it must also establish the minimum living requirements to support the imported technicians. This

generally means things like radio, television, telephone, medical facilities, etc. Sometimes these installations will pass on the benefits of their different technologies in those fields to the surrounding sites. This is done for a number of reasons, and with it the seed is normally planted for the necessary operational environment in which future technicians might develop. This certainly holds true for those enterprises which realise that it is usually less expensive to train native technicians than to import them whenever needed. Often, to create goodwill among the local populace, a communications net will be extended, or portuary facilities will be financed, or roads built for common use. All of these instances are examples of doings which in general expand the current state of existing technology in a specific sector. Of course, there is no mention here, and each nation must evaluate each case individually, of the overall cost of the foreign operation for the country. Whether what is being taken is greater than, or equal to what is being given and act accordingly. In other words, a cost-benefit analysis on the matter should be done.

All of these points having been briefly reviewed, one more, of vital importance needs to be stated and analyzed. That is, since computers are going to be imports virtually all the time in a developing country, the economics of said land constitute a determining factor for the general development of the industry at a national level. The machines that might be imported are also limited in capacity, speeds, and other characteristics by price. This limitation can take many additional forms, and have a large number of distinct effects. Thus,

while all decisions concerning selection of computer equipment might be done on an individual basis, there will be an aggregate effect at the national level. The best solution to a problem must always imply that it be feasible economically, otherwise it cannot be defined as being a solution at all.

After this overview of the points in question, it becomes necessary to describe the method which shall be utilized in detail. This will be done by presenting all the factors going into the analysis, and their respective weights for our specific purpose. Based on the five different questions asked previously as having a direct bearing on the introduction of a computer installation, a grouping of relevant associated factors will be divided into three general classes:

1. Economic
2. Educational
3. Technological

Within economic factors, all those which directly affect the country's capacity to afford computers at different levels, or that characterize the growth trends in the general economy, or that define modes of economical operations are to be included. Under educational, literacy rate, secondary school and higher level enrollment, as well as general status of technical education will be covered. By technological factors are meant those that yield a certain measure of the current state of technology in a country. That is, the indicators for the necessary technological environment to support computer installations at different stages.

A definite set of values will be assigned to different factors within

the mentioned sectors. The values will be determined by the relevance of that factor with respect to the point in question: potential for the development of a computer industry. Once a total quantification of all articles is accomplished, groupings by each class will be done. And upon reaching a final ranking, a creation of subgroups shall be determined. These last will be in combination with still another breakdown by absolute economic magnitude (GNP) in order to fully integrate the concept of a nation's potential for computerization and the overall economic size of said country.

The general weight distribution for the three main classes is the following:

Economic	50%
Educational	20%
Technological	20%

These percentages reflect in a circular way, both the importance of the set of factors included in the class, and the manner in which these define the general classification. Since this attempted categorization is based, to a certain extent, on subjective evaluations and manipulations of objective information, a checking mechanism is established by utilizing a top-down method of assigning weights. Therefore, by determining the overall importance of the general class initially, a bound is automatically imposed on the component factors.

Economically, the measures to be included are four. These four indicators should give adequate measures for the financial aspects dealing with the introduction of a new and expensive technology in

general, and in particular to that of computers. Due to their relative importance in predetermining this position, the weighing scheme chosen for them is the following:

30%	1.	Gross National Product (GNP)
15%	2.	Per capita GNP
5%	3.	Growth rates of GNP and per capita GNP combined
10%	4.	Percent of GDP in "high technology" areas

In reality there are some other parameters with which there is concern as to their applicability in this area. For example general attitudes toward machinery and automation. Nonetheless, most of this type information is extremely difficult to obtain, almost impossible in the short run. Thus, it has been decided to make do with approximations through the best use of parameters such as those listed, and which are connected and underlying those desired but unobtainable.

Included in the broad class of education are the following factors: literacy rate, relative number of students enrolled in secondary school or above, and lastly the level of technical education in the land. Although the choice of these factors obeys a direct relation to how they eventually affect the development of the computer industry, there are some additional points that have been left out, due to the lack of data on record. For instance, it is relevant to analyze the trends toward technical education and how that might impact the general area under study. It would be specifically pertinent, also, to take into account any existing institutions specializing in systems

education. The fact is, however, that the existence of these types of schools are still at an operational level that either makes it very hard to identify them, or makes their contribution almost not worthwhile taking into consideration. The distribution of weights among the selected factors is according to the following scheme:

10%	1.	Literacy rate
5%	2.	Relative number of students enrolled in secondary school or above.
5%	3.	Level of technical education

In the more difficult area of attempting to measure the current state of technology in a country, the factors involved must fulfill the following two requirements: accessibility, and that they shed light on the general technological environment of the country. This is not always easy, since there are many countries in Latin America where present volumes of computer operations are trivial and governments have no awareness of the problems at hand. There are some cases, however, as indicated by the OAS report on the subject matter, (Bibl. 21) where operations have reached a level of certain significance. The factor is, therefore, to be considered, but since in the most notable of all cases even, the stage is incipient compared to future development, a low weight assignement is in order. Other more specific information would be of relevance here, in trying to measure the state of technology. Most of it is, unfortunately, inaccessible. It becomes then logical to utilize the more general parameters at hand in order to at least get a handle on the problem. These are to be the following factors: electricity generation, number of telephones per

thousand, number of television sets, and level of computer usage in the country. These are to be weighed thusly:

8% 1. Electricity produced

7% 2. Number of telephones per thousand

2% 3. Number of television sets installed

3% 4. Level of computer usage

There is a definite reason for intermixing absolute (i.e., GNP) and per capita factors in the analysis. Since one of the the most relevant facets in determining computer technology to be utilized is the level of operation of an enterprise, and this is something which is absent from our collected data, a surrogate must be used. A combination of absolute and per capita factors which define certain aspects within a country is to act as that substitute, insuring that direct absolute measures of a country's magnitude and operational level are passed on.

Basically, this completes the list of factors to quantify towards the categorization. For practical purposes a code will be set up to identify each of these factors for later ease of handling. This code will divide the three main classes, or sectors, with their particular components, assigning a two character identifier to each.

A valid point which must be made concerns the degree of correlation among many of the variables. There is little doubt, for example, that literacy rate and GNP are usually correlated. However, for the purpose of obtaining a workable classification, if crude, the set of factors

chosen seem adequate.

Once the weights have been proportionally assigned, another issue concerning the allocation of points comes up. Mainly, how are they to be allotted to the individual countries for each one of the corresponding articles. There are various methods of doing this, but the one chosen for application is very simple and direct. For each of the eleven factors to be evaluated within the three sectors, the country that comes first according to absolute ranking becomes the base for that particular column. The number of points assigned to that country will be maximum, and all other countries will receive in proportion to their percentage of the base. For example, say that for A2 (per capita GNP) Argentina has the highest entry with $770. Since A2 has a total weight of 15% assigned, then the point distribution for A2 to all countries would follow from the formula. For country X, it would be:

Points for country X:

(per capita GNP for X/per capita GNP of base) x 0.15

= (per capita GNP for X) x (0.15/770)

For Chile, with a per capita GNP of $433, its point allocation would be:

(433) x (0.15/770) = 8.42

There are anumber of cases where the data at hand must be qualified in order to present it in the proper perspective. The problems encountered in the data collection and filtering are the topic of another section. However, since there are a few instances that might affect calculations, let it be mentioned that in junctures where a specific point, or year, was missing from the normal information sources a projection was made based on the trends and growth rates. At times, the last available figure was taken, at others, averages over periods were preferred. In all cases the criterion was to choose the most significant statistic.

TABLE 1

Table of Weighing Factors and their Identifying Codes

	Sector A: ECONOMIC
A1	Gross National Product (GNP)
A2	Per Capita GNP
A3	Growth Rates of GNP and Per Capita GNP Combined
A4	Percent of GDP in "High Technology" Areas
	Sector B: EDUCATIONAL
B1	Literacy Rate
B2	Relative Number of Students Enrolled in Secondary School or Above
B3	Level of Technical Education
	Sector C: TECHNOLOGICAL
C1	Electricity Produced
C2	Number of Telephones per Thousand Inhabitants
C3	Number of Installed Television Sets
C4	Level of Computer Technology

TABLE 2

Chart of Factors and Assigned Weights

Sector A: Economic (60%)

A1------30

A2------15

A3-------5

A4------10

Sector B: Educational (20%)

B1------10

B2-------5

B3-------5

Sector C: Technological (20%)

C1-------8

C2-------7

C3-------2

C4-------3

National Magnitude Sets

Parallel to the development of an index for classifying according to the factors affecting an incipient computer industry, it becomes necessary to create a separate grouping of the Latin American nations by their economic magnitudes. That is, a differentiation on size using an economic scale. The primary reason for this relates to the basic tenet that unequal levels of operation, different volumes of transactions, and distinct magnitudes of corporate entities usually require unique approaches to computerization. These levels, or operational scales, are more likely than not to duplicate themselves in countries of similar economic magnitude. While it is true that two countries might be of comparable economic size and totally dissimilar in population or surface area, it stands that those elements which force the relative equality or disequality are precisely the ones under scrutiny for our main categorization.

Since the most widely used index of economic size is the GNP, and it is desired to obtain a general grouping corresponding, approximately, to large, medium and small countries from an economic viewpoint; then a distribution shall be made using the logarithm of the GNP. What this signifies is that a breakdown will be obtained of countries with GNP's in the hundred million, billion, or ten billion scales. These shall be called National Magnitude Sets I, II, and III, respectively. (See Table 15.)

SOURCES AND RELIABILITY OF DATA

The sources of data for this work are varied, but the bulk of information is derived from five main sources. These are:

(Numbers in parentheses are the Bibliography reference.)

a) America en Cifras 1970, Situacion Economica 2, 3: (Bibl. 19,20)

b) Statistical Compendium of the Americas 1969: (Bibl. 23)

c) Higher Education in the American Republics: (Bibl. 4)

d) The World Tables: (Bibl. 26)

e) Report of Mission for Evaluation of Information Systems, OAS: (Bibl. 21)

For operational speed, a codification of these sources follows:

a) AEC

b) SC

c) HEA

d) WT

e) RME

All of these documents, or books, offer a fairly accurate set of data

for one or more of the factors under analysis for this study. By fairly accurate, however, it is not meant that the up-to-the-minute datum is available and error free all of the time. Fairly accurate data implies, for the purposes of the present work, that which being available was also acceptable when compared to the majority of all possible sources. The reliability of this information, nonetheless, is in the domain of organizations as prestigious as the Organization of American States (OAS) and the International Bank for Regional Development (IBRD). These institutions are by no means infallible, however, and since many times they cannot confirm at all any information which they receive from the various countries, the raw data passed along may still carry some original error. Short of massive and exhaustive surveys in the field---which are economically infeasible---we must rely on this information and function with whatever confidence it may provide.

The breakdown of sources of different factors is of relevance to any one desiring to pursue the reliability of figures used in the different parts of the work. For the economic data (A) an almost total dependance was placed on the World Tables, factors A1 through A4 being taken from there. Per capita GNP and growth are rather straightforwardly picked from said tables: World Table IV (Resources, Product and Income) and World Table I (Growth Rates), respectively. The percentage of GDP in high technology areas, however, has to be computed by adding the specified columns under the headings "GDP by Branch: Electricity, gas and water & Transport and Communications" in World Table IV, also.

The educational data (B) stems from three of the five main sources. Factor B1, literacy rate, is obtained from World Table II (Population, Labor Force and Education). Factor B2, students enrolled in secondary education or above, comes from SC. The level of technical education, B3, comes from a semi-objective analysis of HEA, RME and other sources.

Lastly, the technological data (C) is derived from two of the principal sources. Factor C1, electricity produced, is obtained from ABC, along with C2, number of telephones per thousand. The number of television sets, C3, comes from SC, and C4, level of computer technology, from RME.

The parameters involved also need a clarification on method of computation, or selection. These will be presented in a separate form.

The listing of sources was primarily an indication to the main source of data for each one of the factors under consideration. They are not, however, the only sources. In effect, when a datum is missing in the indicated document it will be obtained from some other document which will be mentioned in the Bibliography. If the information cannot be retrieved by said method, then an estimate is made, based on past figures, trends, growth rates, and other factors.

Two other constant sources of problems are the data concerning Puerto Rico and Cuba. In the first case, because Puerto Rico is not a member

of the OAS, the documents published by said organism carry no information on it. In the case of Cuba, since it has not been within the OAS since 1964, and because of the Cuban government's policy of not putting out very much data on any aspect of its economy, the information which is available is not very complete or up to date. In both of these cases the methods mentioned above concerning missing data have been utilized, although in the Puerto Rican instance, much of the information was obtained from non-OAS sources and incorporated.

In addition to the sources already mentioned, there are a number of further documents that proved invaluable in the preparation of the study. The "Statistical Bulletin of the Pan American Union (Boletin Estadistico de la Union Panamericana)" was used quite extensively to complement much of the data needed. "Socio-Economic Progress in Latin America," an annual report prepared by the IBRD, served to evaluate some of the more subjective aspects in the data analysis.

In due fairness, not all sources relate directly to hard data, since part of the investigation consisted in attacking some problems which are common to other general areas of development. "The Economics of Development," by Everett E. Hagen, and personal discussions with him served the purpose of dissipating many doubts.

TABLE 3

Table Relating Factors to Most Common Source

FACTOR	SOURCE
A1	WT4
A2	WT4
A3	WT1
A4	WT4
B1	WT2
B2	SC
B3	HEA RME
C1	AEC
C2	AEC
C3	SC
C4	RME

TABLE 4

Description of Method for Determination of Parameters

ECONOMIC

A1 Gross National Product

Latest available figure, taken from column 16 of WT4, given in millions of dollars. (1969)

A2 Per Capita GNP

Latest available figure, taken from column 17 of WT4, given in dollars. (1969)

A3 Groth Rates of GNP and Per Capita GNP Combined

Sum of the averages of columns 2 and 3 of WT1 respectively, given in absolute numbers. (1951-69)

A4 Percent of GDP in "High Technology" Areas

Sum of the latest available figures from columns 10 and 11 of WT4, given as percent of GDP. (1968)

TABLE 5

Description of Method for Determination of Parameters

EDUCATIONAL

B1 Literacy Rate

Latest available figure from column 15 of WT2, given as percent of total population. (1969)

B2 Relative Number of Students Enrolled in Secolary School or Above

Sum of latest available figures from Tables 58 and 59 of SC, respectively, divided by the total population. (1967)

B3 Level of Technical Education

Assigned ranking on a one-hundred point scale based on the quantitative and qualitative information of HEA and RME.

TABLE 5

Description of Method for Determination of Parameters

TECHNOLOGICAL

C1 Electricity Produced

Latest available figure in Table 325-01 of AEC2, given in millions of kilowatt-hours. (1968)

C2 Number of Telephones per Thousand

Latest available figure in Table 334-11 of AEC3, given in number of telephones per thousand. (1969)

C3 Number of Television Sets Installed

Latest available figure in Table 60 of SC, given in thousands of television sets. (1966)

C4 Level of Computer Technology

Assigned ranking on a one-hundred point scale based on the quantitative and qualitative information of RME.

TABLE 7

Raw Data For Economic Sector

COUNTRY	A2	A1	A3	A4
ARG	770	18,190	6.3	12.8
BOL	149	716	6.6	9.4
BRA	231	20,967	10.1	9.0
CHI	433	4,147	4.6	6.7
COL	251	5,141	7.0	8.1
COS	423	710	11.6	5.6
CUB	275	2,274	-2.2*	8.0**
DOM	234	977	5.3	9.2
ECU	200	1,137	6.4	5.2
ELS	248	840	4.4	7.1
GUA	293	1,471	6.6	6.4
HAI	55	303	-2.3*	3.5
HON	223	556	6.5	7.6
MEX	476	23,304	9.9	4.3
NIC	342	648	7.5	7.7
PAN	550	794	11.3	7.7
PAR	204	470	6.6	5.4
PER	297	3,196	4.8	5.4
PRC	1,192	3,245	13.0	9.9
URU	473	1,362	-1.2*	8.2
VEN	842	8,445	6.7	6.7

* Minus sign indicates negative growth rate.
** Estimate based on indirect information.

A1	Gross National Product (GNP)
A2	Per Capita GNP
A3	Growth Rates of GNP and Per Capita GNP Combined
A4	Percent of GDP in "High Technology" Areas

TABLE 3

Raw Data for Educational Sector

COUNTRY	B1	B2	B3
ARG	91.5	4.94	100
BOL	39.8	2.60	60
BRA	71.0	3.84	98
CHI	89.6	4.08	94
COL	72.9	3.15	87
COS	34.4	3.96	72
DOM	53.1	1.83	65
ECU	69.7	2.55	65
ELS	49.0	2.14	68
GUA	37.9	1.37	69
HAI	22.0	0.59	40
HON	47.3	1.38	60
MEX	83.7	2.35	95
NIC	49.8	1.98	70
PAN	76.7	6.15	72
PAR	74.4	1.97	60
PER	61.1	3.58	90
PRC	81.0	9.64	90
URU	90.5	4.84	79
VEN	73.9	4.68	85

B1 Literacy Rate
B2 Relative Number of Students Enrolled in Secondary School or Above
B3 Level of Tecanical Education

TABLE 9

Raw Data for Technological Sector

COUNTRY	C1	C2	C3	C4
ARG	17,902	67.2	1,850	100
BOL	673	6.8	0	60
BRA	38,181	17.2	2,500	98
CHI	6,793	33.0	55	74
COL	6,522	28.5	400	87
COS	689	30.0	65	72
CUB	3,709	29.7	555	75
DOM	699	8.7	65	65
ECU	750	15.2	55	65
ELS	582	11.1	38	68
GUA	526	7.3	60	69
HAI	78	0.9	10	40
HON	205	4.5	10	60
MEX	22,731	24.4	1,850	95
NIC	484	12.5	19	70
PAN	520	40.0	77	72
PAR	179	6.5	0	60
PER	4,880	12.7	275	83
PRC	4,895	92.3	700*	90
URJ	1,960	72.4	225	79
VEN	10,369	35.1	700	85

* Estimate based on indirect information.

C1 Electricity Produced
C2 Number of Telephones per Thousand Inhabitants
C3 Number of Installed Television Sets
C4 Level of Computer Technology

TABLE 10

Computations to Convert from Raw Data to Points

FACTOR	WEIGHT	BASE	MULTIPLIER
A1	30	23,304	0.00129
A2	15	1,192	0.01260
A3	5	13	0.38400
A4	10	12.8	0.78100
B1	10	91.5	0.10920
B2	5	9.64	0.52000
B3	5	100	0.50000
C1	10	38,181	0.00021
C2	7	92.3	0.07580
C3	2	2,500	0.00080
C4	3	100	0.03000

A1 Gross National Product (GNP)
A2 Per Capita GNP
A3 Growth Rates of GNP and Per Capita GNP Combined
A4 Percent of GDP in "High Technology" Areas
B1 Literacy Rate
B2 Relative Number of Students Enrolled in Secondary School or Above
B3 Level of Technical Education
C1 Electricity Produced
C2 Number of Telephones per Thousand Inhabitants
C3 Number of Installed Television Sets
C4 Level of Computer Technology

TABLE 11

Point Distribution in Economic Sector

COUNTRY	A1	A2	A3	A4	TOTAL
ARG	23.40	9.70	2.42	10.00	45.52
BOL	0.92	1.87	2.54	7.35	12.68
BRA	27.00	2.31	3.88	7.04	40.83
CHI	5.33	5.45	1.77	5.24	17.79
COL	6.62	3.16	2.69	6.33	18.80
COS	0.92	5.33	4.46	4.38	15.12
CUB	2.93	3.46	-0.84	6.25	11.80
DOM	1.27	2.95	2.04	7.20	13.46
ECU	1.47	2.52	2.46	4.07	10.52
ELS	1.08	3.12	1.69	5.55	11.44
GUA	1.90	3.69	2,54	5.00	13.14
HAI	0.39	0.82	-0.88	2.74	3.07
HON	0.76	2.81	2.50	5.94	12.01
MEX	30.00	6.00	3.81	3.36	43.17
NIC	0.83	4.31	2.88	6.02	14.04
PAN	1.02	7.05	4.35	5.40	17.82
PAR	0.61	2.57	2.54	4.22	9.94
PER	5.04	3.74	1.85	4.22	14.85
PRC	4.18	15.00	5.00	7.74	31.92
URU	1.76	6.05	-0.46	6.40	13.75
VEN	10.90	10.62	2.58	5.24	29.34

A1 Gross National Product (GNP)
A2 Per Capita GNP
A3 Growth Rates of GNP and Per Capita GNP Combined
A4 Percent of GDP in "High Technology" Areas

TABLE 12

Point Distribution for Educational Data

COUNTRY	B1	B2	B3	TOTAL
ARG	10.00	2.56	5.00	17.56
BOL	4.34	1.35	3.00	8.69
BRA	7.74	1.99	4.90	14.63
CHI	9.75	2.12	4.70	16.58
COL	7.95	1.68	4.35	13.98
COS	9.20	2.06	3.60	14.86
CUB	8.49	1.87	3.75	14.11
DOM	5.80	0.95	3.25	10.00
ECU	7.60	1.32	3.25	12.17
ELS	5.35	1.11	3.40	9.86
GUA	4.14	0.71	3.45	8.30
HAI	2.40	0.36	2.00	4.76
HON	5.15	0.72	3.00	8.87
MEX	9.13	1.24	4.75	15.12
NIC	5.42	1.03	3.50	9.95
PAN	8.35	3.19	3.60	15.15
PAR	8.10	1.02	3.00	12.12
PER	6.66	1.86	4.15	12.67
PRC	8.32	5.00	4.50	18.32
URU	9.85	2.51	3.95	16.32
VEN	8.05	2.43	4.25	14.73

B1 Literacy Rate
B2 Relative Number of Students Enrolled in Secondary School or Above
B3 Level of Technical Education

TABLE 13

Point Distribution in Technological Sector

COUNTRY	C1	C2	C3	C4	TOTAL
ARG	3.76	5.09	1.48	3.00	13.34
BOL	0.14	0.51	0.00	1.80	2.45
BRA	8.00	1.29	2.00	2.94	14.23
CHI	1.42	2.50	0.04	2.22	6.18
COL	1.37	2.16	0.32	2.62	6.47
COS	0.14	2.23	0.05	2.16	4.63
CUB	0.73	2.25	0.44	2.25	5.72
DOM	0.15	0.66	0.05	1.95	2.81
ECU	0.16	1.15	0.04	1.95	3.30
ELS	0.12	0.84	0.03	2.04	3.03
GUA	0.11	0.55	0.05	2.07	2.78
HAI	0.02	0.07	0.01	1.20	1.30
HON	0.05	0.34	0.01	1.80	2.20
MEX	4.76	1.85	1.48	2.85	10.94
NIC	0.10	0.95	0.02	2.10	3.17
PAN	0.11	3.02	0.06	2.16	5.35
PER	1.03	0.95	0.20	2.49	4.67
PRC	1.03	7.00	0.56	2.70	11.29
URU	0.41	5.49	0.18	2.37	8.45
VEN	2.17	2.66	0.56	2.55	7.94

C1 Electricity Produced
C2 Number of Telephones per Thousand Inhabitants
C3 Number of Installed Television Sets
C4 Level of Computer Technology

TABLE 14

Ranking by Sector

COUNTRY	ECON.	EDUC.	TECH.
ARG	1	2	2
BOL	15	18	18
BRA	3	9	1
CHI	8	3	8
COL	6	11	7
COS	9	7	12
CUB	17	10	9
DOM	13	14	16
ECU	19	13	13
ELS	13	16	15
GUA	14	20	17
HAI	21	21	21
HON	16	17	20
MEX	2	6	4
NIC	11	15	14
PAN	7	5	10
PAR	20	14	19
PER	10	12	11
PRC	4	1	3
URU	12	4	5
VEN	5	8	6

TABLE 15

Table of Computer Industry Development Potential (CIDP) Indicator Groups

	COUNTRY	CIDP
	ARG	76.42
(GROUP A)	BRA	69.69
	MEX	69.23
(GROUP B)	PRC	61.53
	VEN	52.01
	CHI	40.55
	COL	39.25
	URU	38.52
(GROUP C)	PAN	38.32
	COS	34.53
	PER	32.20
	CUB	31.63
	NIC	27.16
	DOM	26.27
	ECU	25.99
(GROUP D)	PAR	24.39
	ELS	24.33
	GUA	24.21
	BOL	23.82
	HON	23.08
(GROUP E)	HAI	9.13

TABLE 16

Table of National Magnitude Sets

COUNTRY	log GNP	
MEX	10.36743	
BRA	10.32154	(SET I)
ARG	10.25983	
VEN	9.92660	
COL	9.71105	
CHI	9.61773	
PRC	9.51121	(SET II)
PER	9.50461	
CUB	9.35679	
GUA	9.16761	
URU	9.12418	
ECU	9.05576	
DOM	8.98989	
ELS	8.92428	
PAN	8.89982	
BOL	8.85491	
COS	8.85187	(SET III)
NIC	8.81158	
HON	8.74507	
PAR	8.67201	
HAI	8.48144	

TABLE 17

Table of Affine CIDP within
National Magnitude Sets

COUNTRY	NMS	CIDP
MEX	I	A
BRA	I	A
ARG	I	A
VEN	II	B
PRC	II	B
CHI	II	C
COL	II	C
CUB	II	C
URU	II	C
PER	II	C
GUA	II	D
ECU	II	D
PAN	III	C
COS	III	C
DOM	III	D
ELS	III	D
BOL	III	D
NIC	III	D
HON	III	D
PAR	III	D
HAI	III	E

ANALYSIS OF CIDP

The indicator arrived at, the CIDP (Computer Industry Development Potential), can be assumed to give at least a crude measure of the potential development of a computer user industry in a country. The indicator range is from 0 to 100, this maximum figure corresponding to an ideal country which would occupy ranking one in all factors A1 through C4. In the present CIDP listing, Argentina is the country with the highest indicator (76.42), and Haiti (9.13) is the one with the lowest.

It is also obvious that the CIDP is a dynamic indicator which changes whenever a new base country for any of the given factors is taken. This would force to a new iteration of CIDP values periodically, which would probably not alter the rankings very much if the time between computations were moderate (i.e., two years).

The CIDP groups, created by bunched distribution of the indicators, now constitute a relatively safe common ground for certain general trends and policies which may compose a guideline for development of the computer industry, and must therefore be operated within the context of the general CIDP concentration groups derived in a previous section. The combination of these two elements yields the composite classification displayed in Table 17. This is a categorization into

functional sets of countries with similar national levels of operation and potential for computer industry development. With this in hand a more detailed analysis of the elements involved in each set can generate an initial framework within which governments can dictate a general policy that will guide the industry, hopefully, to yield an effective and efficient contribution to the national development.

As to the criteria used in the creation of the CIDP groups, a certain amount of bias was admittedly present, though fundamented on pragmatic observations and personal experience. The ARG, BRA, MEX triangle was clearly one group. Also standing out at the lower end was Haiti all by itself. The 4.47 point spread between CUB and NIC was the significant gap in the whole CHI (41.15) to HON (23.08) range. The question of placing PRC and VEN was a matter of some initial concern, since the first was actually closer to MEX than to VEN. However, since the whole question of the Puerto Rican situation, because of its special relationship with the United States, is open to question; it seemed logical to place it with VEN, whose oil rich economy also places it in a special position.

The last point to be made concerns the fact that the data utilized is relatively dated. Working with the World Tables of February 1971, which reflects conditions of at least 15 months prior, the results must be looked at carefully. However, upon actual field research on the state of computation in the different Latin American countries it

was determined that the categorization stands relatively firm still with two exceptions. These are Argentina and Nicaragua. In the case of Argentina, it is clear that at this point it has fallen behind both Brazil and Mexico. this is probably due to the effects of the political instability and its economic repercussions over the last few years. Nicaragua owes its drop basically to the earthquake of December 1972, when the whole country's economy was set back considerably. In addition, an observation must be made concerning Cuba. Due to its basic political and economic differences with respect to the rest of Latin America, its position in the categorization may be challenged. The variables selected don't necessarily have the same meaning here. And Cuba's decision to manufacture minicomputers, and implement a national computation system, give it certain advantages within the technology area over the other Latin American nations.

CHARACTERIZATION AND SUMMARY

Once the categorization has been established, it becomes interesting to look at the results a bit more closely. There are five CIDP groups, identified by the letters A to E. The ascending alphabetical order is indicative of a lower rating in CIDP score. The members of Group A have a higher index than those of Group B, C, D, or E, and are thus assumed to have a higher potential for developing a computer industry. Within each group there are some differences in range, although no inter-group gap is smaller than an intra-group gap, with the exception of the Mexico-Puerto Rico, Puerto Rico-Venezuela gap. That is, between the last country of Group A (Mexico) and the first country of Group B (Puerto Rico), there is a larger point difference than between Puerto Rico and its immediate lower neighbor within Group B (Venezuela). Due to its special political and economical association with the United States, Puerto Rico's situation in Group B is very much a reflection of the vast CIDP of the United States, and any attempt to place it in a higher group would be inappropriate. Out of the twenty-one nations studied the count within the different groups was as follows:

Group A	3
Group B	2
Group C	7
Group D	8
Group E	1

This tally is interesting from various points of view, but some of these will become obvious as we undertake the characterization of the different groups. It also becomes relevant to identify geographically

pools based on their group membership, for a possible regional center analysis.

It is now proper that certain tangible attributes be identified with the CIDP groups. What characteristics do the members of a same class have in common? How does one country advance or descend into another group? Can one assume that similar lines of action are possible within the same group? An attempt to answer these questions begins with the characterization of the groups. In order to do this, two primary sources will be relied upon. The first of these is personal experience. The second is definition of levels of computer activity done by the ACAST Working Group on Computer Technology (1) and presented in their 1971 publication (2). The levels defined are abstracted in the following manner:

> INITIAL: There are no operational computers in the country. A few nationals have had contact with computing. The only local sources of information are computer salesmen.
>
> BASIC: There is some understanding of computers in government and private decision centers. A few computer installations are to be found. There are some nationals involved in computer operations. There is some education and training in computer technology in the country. Computers are used in basic government operations.
>
> OPERATIONAL: There is extensive understanding of computers in government and private decision centers. Among the numerous computer installations there are some very large machines. There are centers for education and training in computer technology and some are of excellent quality. They offer degree programs in computer or information science. There is design and production of software and some manufacture of hardware. Computers are affecting many disciplines, particularly science, medicine and engineering.

> ADVANCED: Most government and administrative work is carried out by computers. There are well established professional activities and national meetings on computers. There is a complete range of quality education and training programs. The number of computers, of all sizes, is increasing rapidly. Time-sharing, teleprocessing and remote job entry are common. There is design and production of both hardware and software. Many technologies have been changed or are in the course of being changed. New applications of computers are found regularly. There is strong participation in and contribution to international activities.

These levels are useful, though not totally complete or well defined, since it is possible for a country to be "basic" in one aspect and "operational" in another. This was recognized by the ACAST-WG as a drawback of the scheme, but it is helpful nonetheless.

If one tries to relate CIDP groups and these activity levels, an interesting situation develops. Of course, the countries of Latin America can be placed within the corresponding level, but in order to properly identify their status an extension of the U.N. level concept is necessary. This is easily done by including the transitions as interim levels also. Once this is done, this characterization of computer activity in a country could be correlated with the CIDP group concept rather nicely. For example, the levels would now appear:

> INITIAL
> INITIAL-TO-BASIC
> BASIC
> BASIC-TO-OPERATIONAL
> OPERATIONAL
> OPERATIONAL-TO-ADVANCED
> ADVANCED

And the characteristics of the interim levels follow from the ones of

the prior level and those of the following one. A correspondence of CIDP groups and levels can now be attempted, and as in Table 17.

TABLE 17

Correspondence of CIDP Groups and
Expanded UN Level Concept

INITIAL*****GROUP E

INITIAL-TO-BASIC*****GROUP D

BASIC*****GROUP C

BASIC-TO-OPERATIONAL*****GROUP B

OPERATIONAL*****GROUP A

OPERATIONAL-TO-ADVANCED**********

ADVANCED**********

A specific characterization of the CIDP groups can now be made utilizing part of the U.N. definitions, and adapting them to a more realistic situation of Latin America.

Group E, which is roughly equivalent to the initial level, does follow that pattern rather closely. There are no operational computers in Haiti (3). Only a few nationals have had some contact with computing. The local sources of information are almost non-existent. The small amount of data processing related activity that exists in the country is some manufacturing of magnetic core memories. The inexpensive labor found offered good incentive for some U.S. manufacturers to establish themselves there for these purposes. Some large scale keypunching is also being done by an American-Haitian combine, through daily deliveries to San Juan, and Miami, but it was still on an experimental basis as of early 1971. There are no major manufacturers marketing very actively in Haiti---IBM does not have an office---but through their office equipment representatives some manufacturers such as NCR, or Burroughs could possibly fill orders should they arise. Group E is at a relatively primitive stage of technological development, and its CIDP components indicate little potential for a future industry.

The members of CIDP Group D are varied, and they come mainly from the Central American and Caribbean area, with the addition of Bolivia, Ecuador and Paraguay from the South American region. Major computer manufacturers are established with marketing offices in all of these countries, with U.S. firms dominant in general. There are relatively few computers in these countries. The applications implemented are

relatively straightforward business applications. With the possible exception of some installations at a large American subsidiary, most machines in the country are small. There is some computing within the government, but it is very unsophisticated. Operations and data preparation are in native hands, as is most simple programming. Almost all systems programming done is imported, as well as most systems analysis and design beyond a minimal level of complexity. Basic information and training is provided by the manufacturer through either importing personnel, or by utilizing extra-national education centers. An interesting development here is the general practice of most manufacturers to provide training at higher levels in the centers of a more advanced country nearby. The potential for sharing and aid among the developing countries in Latin America is great, and the groundwork is laid in this manner. Thus, most of Central America travels to Mexico for computing education. Most of southern South America goes to Argentina, and northern South America generally drifts toward Venezuela or Mexico. Brazil is not as utilized due to the language difference, and the United States is left further in reserve for complex systems problems. A typical Group D country has very little in the way of strong private (non-manufacturer) DP education. Keypunching and operations, as well as some concepts of mechanized accounting are generally given within the commercial curriculums of secondary schools, or in independent commercial training centers.

Group C is the most heterogeneous of all, and therefore the most difficult one to analyze and characterize. With members as far apart as Chile and Panama, Cuba and Uruguay, it is not easy to assign any

specific global set of attributes to the group. In addition, since CIDP attempts to indicate potential for the establishment of a computer user industry, it is a function of the country's politics by way of their effects on the economic, educational and technological status. Therefore it will increase or decrease, depending on the benefits of the overall conduct of a government's activities. A classic case, in this sense is Cuba, where due to its political philosophy and its international repercussions, no computers actually entered the country from 1960 to 1967, with the exception of one used Elliott 803 (4). Of course, the circumstances which sometimes cause these occurrences can very rarely be predicted by CIDP. Nonetheless, Group C countries generally present the following situation. A considerable number of computers exist in the country. Most all programming is done by native personnel, even some systems programming. Systems analysis and design is rapidly being taken over by natives, as is most DP management. Service bureau operations appear with some consistency. Most of the manufacturers staff is also native, with the possible exception of top management. Business schools offer relatively good programs in DP activities, such as computer programming, computer operation, etc. Universities offer computer related courses, primarily within their business, science and engineering curriculums. In some cases, independent degrees in computer science, or concentration in programming within Mathematics is offered.

A note must be made here to explain the case of Cuba, which does not fit in to the picture very smoothly. Due to its isolation from the

Inter-American system, for reasons not relevant to discuss , Cuba has followed a relatively different path toward the development of a computer industry. Under a totally centralized economic system, and a unique educational structure, the country has embarked on a very ambitious program for developing their potential. Guided by French advisors as of 1958, (6) the government has acquired a number of IRIS series computers, and has even been attempting to manufacture their own small 4K machine. Thus, it is very difficult to compare Cuba with the rest of the Latin American nations, since their models are so different. In addition, very little information actually leaks out on what is occurring inside of Cuba technologically. Yet it is hoped that this study will also aid in placing this Island in its proper perspective with respect to the rest of Latin America.

With the exception of Group E, the smallest of all is B, with only two members: Puerto Rico and Venezuela. While the two countries are quite distinct there are also remarkable similarities and cultural patterns. As far as their potential for a computer industry, both score high at present. At the same time, there is also a certain artificiality in their economies. In Puerto Rico, it is a direct connection to the United States, and in Venezuela it is an indirect one through the petroleum industry. In both cases the future is very much dependent on these special relationships. Nonetheless, the characteristics of Group B are clear, reflecting very much the U.S. influence in the computer field. Systems analysis and development, as well as programming, are totally in native hands. User groups are organized and some information sharing is done. Professional organizations are

incipient. Data processing schools are established wholly dedicated to systems training. A FAIR amount of consulting is beginning to be done by natives, and some software is being produced. Many computer-oriented courses or full-time computer science curriculums now exist in the universities. Some teleprocessing systems are established, and time-sharing is beginning to be studied. Government participation and awareness increases beyond the point of just being a major user. An internal consulting office is usually established within the government, and a centralized installation serves as a leader for the industry.

Group A probably presents the most homogeneous front. Of course, there are vast differences between Argentina, Brazil and Mexico. Yet, when one compares them to the diversity of Group C, they seem minor. The level of technological advancement in the three countries is relatively similar, and economically they are also remarkably close. Of course, Brazil still remains the great "sleeping giant" of Latin America, and is only now giving signs of waking up. If and when it does, it will probably expand beyond predictions. There is some fear already, within South American circles, of Brazilian "imperialism" as forewarned by the many entreprenuers extending beyond its own borders and setting up shop in Peru, Uruguay, Bolivia, Paraguay, and Colombia, among others. Argentina also presents an interesting panorama. The most educated of Latin American states (91.5% literacy), it has had some major political difficulties in the last decade. This has had a negative effect on its economy. A rather bleak picture could develop in the future unless some stability is eventually obtained. Such a

relatively stable politics as Mexico presently enjoys, would be welcome by Argentina. Mexico has shown a gradual increase and improvement in most sectors, leading to an environment in which a computer user industry of some sophistication is already supported. Of course, its proximity to the United States has been an important factor. In general, Group A countries have most government and administrative work carried out by computers. There are well established private DP schools. Manufacturers and consultants offer sophisticated systems courses. Professional DP organizations are already fairly well the norm. User groups are effective. There is increasing participation in, and sponsorship, of international DP-related activities. Certain support for neighboring less advanced lands is attempted. Universities offer formal degree programs in the computer or information sciences. Planning and policy for the development of the data processing industry is also a concern of government, and some involvement in the matter is desired. Certain trend towards the manufacturing of small systems is seen within academic circles.

This description of the CIDP groups has loosely presented the general situation for the member countries. The characteristics of the different groups can be presented more compactly, and summarized in the following manner:

GROUP E No operational computers in country.
Very few nationals have had contact with computers.
Almost no local sources of information.

Manufacturers barely established for marketing.

GROUP D Relatively few computers in country.

Manufacturers well established in country.

A few government installations doing administrative work.

Operations and data preparation, as well as most elementary programming, in native hands.

Systems analysis and development, and DP management mostly imported.

Basic systems training provided by manufacturer.

Business schools commencing to offer some courses in keypunching, operations and mechanized accounting.

GROUP C Considerable number of computers in country.

All programming done by native personnel, even some basic systems programming.

Systems analysis and design being rapidly taken over by natives.

Adequate service bureau operations appear with consistency.

Business schools offer good programs in DP activities, such as operations, keypunching, mechanized accounting.

Universities commence to offer some computer-oriented courses within their business, science and engineering curriculums.

Some initial government awareness of computer industry as an entity in itself

Insinuations of user groups and professional organizations.

GROUP B Considerable number of computers in country, including some fairly large ones (6).

Systems analysis, development and DP management at almost all levels carried out by native personnel.

Some relatively complex applications implemented.

Elementary teleprocessing systems are established.

User groups are organized as well as professional organizations, although they yield very little actual benefit to members.

Data processing schools are established, totally dedicated to systems education.

Consulting tasks now taken on increasingly by native personnel, and some software production commenced.

Heavy computer-oriented courses given at universities, including probable concentrations in programming within the mathematics or engineering departments.

Government awareness and participation increase.

GROUP A Large number of computers in country (7), in most ranges, sizes and models.

Most major government and administrative work carried out by computers.

Well established private data processing schools.

Consultants and manufacturers offer sophisticated systems courses.

Professional DP organizations flourish.

User groups largely increase their productivity and information sharing is incremented.

Participation in and sponsorship of international activities is incipient.

Some support offered to neighboring less advanced countries.

Universities offer formal degree programs in computer or information sciences.

Planning and policy for the industry seen as major concern by government, and some research is done in the matter.

Certain work done towards the manufacture of small systems, mainly in academic or government circles.

TABLE 19

General Information on the Latin American Nations

COUNTRY	ABBR.	CAPITAL	AREA (SQ. MI.)	POP. (M)
ARGENTINA	ARG	BUENOS AIRES	1,072,068	24.352
BOLIVIA	BOL	SUCRE (LA PAZ)	424,163	4.931
BRAZIL	BRA	BRASILIA	3,286,473	92.238
CHILE	CHI	SANTIAGO	292,257	8.836
COLOMBIA	COL	BOGOTA	439,513	21.116
COSTA RICA	COS	SAN JOSE	19,653	1.766
CUBA	CUB	LA HABANA	44,218	8.250
DOMINICAN REP.	DOM	SANTO DOMINGO	18,703	4.012
ECUADOR	ECU	QUITO	104,506	6.093
EL SALVADOR	ELS	SAN SALVADOR	8,083	3.515
GUATEMALA	GUA	GUATEMALA	42,042	5.170
HAITI	HAI	PORT-AU-PRINCE	10,714	4.867
HONDURAS	HON	TEGUCIGALPA	43,277	2.582
MEXICO	MEX	MEXICO CITY	759,530	48.313
NICARAGUA	NIC	MANAGUA	53,668	1.982
PANAMA	PAN	PANAMA CITY	29,208	1.415
PARAGUAY	PAR	ASUNCION	157,047	2.374
PERU	PER	LIMA	494,293	13.586
PUERTO RICO	PRC	SAN JUAN	3,435	2.677
URUGUAY	URU	MONTEVIDEO	72,172	2.886
VENEZUELA	VEN	CARACAS	347,029	10.399

SOURCE: 1970 figures from "Socio-Economic Progress in the Latin American," Inter-American Development Bank 1970 Annual Report.

Puerto Rico information from "World Almanac".

REFERENCES

1) An ad hoc Working Group was established by the ACAST (Advisory Committee on the Application of Science and Technology to Development) to do the initial investigations on computer technology that led to the publication of the pamphlet in (24).

2) UN ACAST, (24) p 50.

3) This was the case as of December 1972.

4) Carnota Lauzan (7), p 2.

5) Personal communication to the author by Ing. Beltran at the Jerusalem Conference on Information Technology, Aug. 1971.

6) See definitions UN ACAST (24), p 29.

7) See definitions UN ACAST (24), p 29.

BIBLIOGRAPHY

1. Allen, T.J., Piepmeier, and Cooney, S., "Technology Transfer to Developing Countries: the International Technological Gatekeeper," Sloan School of Management Working Paper, MIT, February 1971.

2. Alvarez, S. and Barquin, R., "The State of Computer Arts in Puerto Rico," Revista del Colegio de Ingenieros, Arquitectos y Agrimensores de Puerto Rico, 20:2 April-May-June 1970.

3. Beltran, S.F., "Computing in Latin America," Datamation, March 1968.

4. Benjamin, H.R.W., Higher Education in the Latin American Republics, McGraw-Hill, New York, 1965, 224pp.

5. Blaxter, C.W., "National Policies in Computer Education and Training---Setting Guidelines for the Developing Countries," Proceedings of the Jerusalem Conference on Information Technology, Jerusalem, 1:89, August 1971.

6. Boehm, B.W., "Computing in South America: Some Observations and Policy Considerations," Datamation, January 1970.

7. Carnota Lauzan, O., "La Aplicacion de las Computadoras en el Campo Economico en un Pais en Vias de Desarrollo: Cuba," Proceedings of the Conference on the Role of Computers in Economic and Social Research in Latin America, Cuernavaca, Mexico, October 25-29, 1971. (To be published by the National Bureau of Economic Research.)

8. Connolly, J., "Chronology of Computing in Africa, Asia, Europe and, Latin America," IBM World Trade Corp., 1968.

9. Cowan, D.D., Olinto, A.C., and Spann, R.N., "Report on Computer Science Education in Certain Latin American Countries," Report Commissioned by the Organization of American States, Washington, D.C.,

10. Friedmann, E., "Management of Computer Resources in Less Developed Countries," Jerusalem Conference on Information Technology, Jerusalem, 1:295, August 1971.

11. Gingold, J.I., "The Potential for High Level Computer Manpower in South America," Sloan School of Management Master's Thesis, MIT, June 1970. November 1969. McGraw-Hill, New York, 1965, 224pp.

12. Glaser, G., "The Centralization vs. Decentralization Issue: Arguments, Alternatives and Guidelines," Data Base (Quarterly newsletter of the ACM's SIGBDP), 2:3 Fall/Winter 1970.

13. Hagen, E.E., The Economics of Development, Richard D. Irwin, Inc., Homewood, Ill., 1968, 536pp.

14. Ness, D.N., "Some Comments on the Role of Computers in Management Education," Sloan School of Management Internal Paper, MIT, April 1969.

15) Pollitzer, G., "Education: The Enzyme for Computer Assimilation," Jerusalem Conference on Information Technology, Jerusalem, 2:76, August 1971.

16. Pool, I.dS., Stone, P., Szalai, A., "Communications, Computers and Automation for Development," UNITTAR Research Report, 1971.

17. Tomlin, R., Managing the Introduction of Computer Systems, McGraw-Hill, London, 1970.

18. ___"America en Cifras 1970, Situacion Economica: 2. Industria," Secretariat General of the Organization of American States, Washington, D.C., February 1971.

19. ___"America en Cifras 1970, Situacion Economica: 3. Comercio, Transporte, Comunicaciones y Turismo," Secretariat General of the Organization of American States, Washington, D.C., February 1971.

20. ___"Informe Anual 1969," Annual Report of the Puerto Rico Development Bank, November 1969.

21. ___"Informe de la Mision de Evaluacion de los Sistemas de Difusion de la Informacion Tecnologica en Uruguay, Argentina, Chile, Peru, Brasil, Venezuela, Colombia y Mexico," Report of the Scientific Department of the Organization of American States, Washington, D.C., January 1971.

22. ___"Puerto Rico in Figures 1969," Publication of the Government Development Bank for Puerto Rico, San Juan, Puerto Rico, 1970.

23. ___"Statistical Compendium of the Americas 1969," Department of Statistics of the Pan American Union and the Inter American Statistical Institute, Washington, D.C., 1969.

24. ___"The Application of Computer Technology for Development," United Nations Publication, New York, 1971.

25. ___"Socio-Economic Progress in Latin America," Tenth Annual Report of the Social Progress Trust Fund of the Inter-American Development Bank, Washington, D.C., February 1971.

26. ___"World Tables," prepared by the International Bank for Reconstruction and Development (IBRD), Washington, D.C., February 1971.

27) Westrick, J.R., "A Policy Towards Better Computer Utilization in Developing Countries," September 1969. (Westrick was an A.I.D. advisor on DP to the Uruguayan equivalent of the Internal Revenue Service.)

Date Due

DEC 29 '78

MAR 25 '87

Lib-26-67

MIT LIBRARIES
3 9080 003 796 478

MIT LIBRARIES
3 9080 003 827 372
674-73

MIT LIBRARIES
3 9080 003 827 273
676-73

MIT LIBRARIES
3 9080 003 827 356
677-73

678-73 →

MIT LIBRARIES
3 9080 02879 3104

MIT LIBRARIES
3 9080 003 796 320
679-73

MIT LIBRARIES
3 9080 003 702 419
680-73

MIT LIBRARIES
3 9080 003 671 374